

IN THE CLAIMS:

Claim 1. (Previously presented) An arrangement of an internal combustion engine poppet valve and a hydraulic actuator therefor comprising:

an actuator housing;

spring means for biasing the poppet valve into engagement with a valve seat therefor;

a first piston of a first cross-sectional area slidable in a first chamber formed in the actuator housing, the first piston having a passage therethrough for the flow of hydraulic fluid; and

a second piston of a second cross-sectional area smaller than the first cross-sectional area slidable in a second chamber formed in the actuator housing, the second chamber opening on to the first chamber; wherein:

the first chamber is connectable to a pressurised hydraulic fluid supply line and to a hydraulic fluid return line;

the second piston has an upper surface engageable by a lower surface of the first piston; and

the first piston is configured without a passage which is both aligned with the second piston and which has a portion of constant cross-sectional area greater than the said second cross-sectional area; whereby:

in order to open the poppet valve: the first chamber is connected to the pressurised hydraulic fluid supply line and then supplied pressurised hydraulic fluid acts initially on the first piston to give rise to a first magnitude force which is initially relayed via the second piston to the engine valve to open the valve; initially the first

piston, the second piston and the engine valve all move together under the action of the first magnitude force until the first piston reaches an end stop; and thereafter the supplied pressurised hydraulic fluid flows from the first chamber through the passage in the first piston to act on the second piston and to thereby give rise to a second smaller magnitude force under the action of which the second piston and the valve move together until the valve is fully open;

in order to close the previously opened poppet valve: the first chamber is connected to the hydraulic fluid return line and then the biassing force applied by the spring means to the valve forces the valve to move back towards its valve seat; initially the valve and the second piston move together with the second piston expelling fluid from the second chamber via the passage in the first piston to the hydraulic fluid return line until the second piston engages the first piston; and thereafter the first piston, the second piston and the valve all move together under the biassing force applied by the spring means with the first piston expelling hydraulic fluid from the first chamber to the hydraulic fluid return line until the poppet valve engages the valve seat therefor; and

the movement of the second piston relative to the first piston is limited by abutment of the upper surface of the second piston with the lower surface of the first piston; wherein

the passage through the first piston has an opening on to the lower surface of the first piston, the said opening being surrounded by an abutment surface;

and the upper surface of the second piston has a matching abutment surface and the matched abutment surfaces abut each other whilst the first and second pistons move together and by abutment seal the passage through the first piston.

Claim 2. (Original) An arrangement of an internal combustion engine poppet valve and a hydraulic actuator therefor as claimed in claim 1 wherein the second piston directly abuts the top of a valve stem of the poppet valve.

Claim 3. (Currently amended) An arrangement of an internal combustion engine poppet valve and a hydraulic actuator therefor as claimed in claim 1 or ~~claim 2~~ wherein the first and second pistons directly abut each other when moving together.

Claim 4. (Currently amended) An arrangement of an internal combustion engine poppet valve and a hydraulic actuator as claimed in ~~any of the preceding claims~~ claim 1 wherein the first chamber is formed in the actuator housing by a first diameter drilling and the second chamber is formed in the actuator housing by a second diameter drilling which is aligned with the first diameter drilling.

Claim 5. (Currently amended) An arrangement of an internal combustion engine poppet valve and an actuator therefor as claimed in claim 1 wherein both of the abutment surfaces are conical.

Claim 6. (Original) An arrangement of an internal combustion engine poppet valve and an actuator therefor as claimed in claim 5 wherein the matched conical surfaces together act to restrict flow of fluid through the passage in the first piston as the second piston comes into abutment with the first piston and thereby soften impact of the first piston with the second piston.

Claim 7. (Currently amended) An arrangement of an internal combustion engine poppet valve and an actuator ~~therefor~~ therefor as claimed in ~~any one of the preceding claims~~ claim 1 comprising a passage through the actuator through which hydraulic fluid trapped between one side of first piston and a facing surface of the first chamber as the first piston approaches the end stop therefor can be relayed to the first chamber on the other side of the first piston.

Claim 8. (Currently amended) An arrangement of an internal combustion engine poppet valve and an actuator therefor as claimed in ~~any one of the preceding claims~~ claim 1 wherein the spring means comprises one or more valve springs acting between a collar attached to the poppet valve and a surface provided on the engine cylinder head.

Claim 9. (Currently amended) An arrangement of an internal combustion engine poppet valve and ~~an a hydraulic~~ actuator therefor ~~substantially as hereinbefore described with reference to and as shown in the accompanying drawing as claimed in claim 1 wherein the first and second pistons directly abut each other when moving together.~~

Claim 10. (New) An arrangement of an internal combustion engine poppet valve and a hydraulic actuator as claimed in claim 2 wherein the first chamber is formed in the actuator housing by a first diameter drilling and the second chamber is formed in the actuator housing by a second diameter drilling which is aligned with the first diameter drilling.

Claim 11. (New) An arrangement of an internal combustion engine poppet valve and an actuator therefor as claimed in claim 2 wherein both of the abutment surfaces are conical.

Claim 12. (New) An arrangement of an internal combustion engine poppet valve and an actuator therefor as claimed in claim 11 wherein the matched conical surfaces together act to restrict flow of fluid through the passage in the first piston as the second piston comes into abutment with the first piston and thereby soften impact of the first piston with the second piston.

Claim 13. (New) An arrangement of an internal combustion engine poppet valve and an actuator therefor as claimed in claim 12 comprising a passage through the actuator through which hydraulic fluid trapped between one side of first piston and a facing surface of the first chamber as the first piston approaches the end stop therefor can be relayed to the first chamber on the other side of the first piston.

Claim 14. (New) An arrangement of an internal combustion engine poppet valve and an actuator therefor as claimed in claim 13 wherein the spring means comprises one or more valve springs acting between a collar attached to the poppet valve and a surface provided on the engine cylinder head.